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An Introduction to Water Pollution Control



Ministry of the Environment

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"We travel together, passengers on a little space ship, dependent on its vulnerable supplies of air, water and soil---preserved from annihilation only by the care, the work, and I will say, the love we give our fragile craft." Adlai Stevenson.

Foreword

So you're interested in pollution.

We, in the Ontario Ministry of the Environment, are glad to hear it. We know that an informed public is vitally important in the fight for an improved environment. Always remember that governments can proceed only as fast as the people will allow; for this reason it is up to all of us to spread accurate, factual information.

One word of caution: constantly bear in mind that the subject of pollution is very complicated and very technical. For this reason, in even the best treatment of the subject on a concise scale, there is a danger of over-simplification. It is far from a simple matter, and will really require much extra reading on your part. But, if you promise to remember this risk, we will try to put down some basic facts to help in your search for information.

AN INTRODUCTION TO WATER POLLUTION CONTROL

What do you mean by pollution? The Oxford Concise Dictionary says "to pollute is to destroy the purity of; make (water, etc.) foul or filthy." Sounds simple enough, but, curiously, pollution means different things to different individuals, even different things to the same person in different circumstances.

For example, distilled water is surely the purest form of water; yet from the standpoint of a fisherman, a lake filled with distilled water would be 'polluted' because no fish could grow in it. Sea water has salt in it, and the sea fish flourish in it. Yet for many purposes, (drinking, use in engines, or as a medium for freshwater fish), it is polluted.

Pollution is usually associated with man and his various activities, but nature herself causes it too. When leaves etc., fall from trees that overhang bodies of water, organic pollution takes place. Where marshes exist, large numbers of bacteria enter the watercourse as a result of decay of the weeds and reeds. This natural decay may cause high 'coliform counts', which may be wrongly interpreted as indicating dangerous pollution.

The accepted level of coliform count in water to be used for swimming is up to 1000 per 100 millilitres, and this level can easily be exceeded near decaying vegetation. Nature usually can look after her own pollution and can cleanse the waters through the action of sunlight, micro-organisms, (minute forms of life, plant and animal,) and cascades or white-water areas in the rivers.

It is only when man overloads her efficient purifying mechanism that trouble occurs and we face situations which may be unsightly, unpleasant and even dangerous to health. It is also well to remember that, as the number of humans increase on earth, and their intellectual and technological ability grows, the possibilities of this abuse of nature's mechanism becomes more probable.

The pollution of Adlai Stevenson's "fragile craft" can be divided into three general areas, though each in actuality overlaps the others: air, water and soil. For our present purposes, we will limit our discussion to water and perhaps pursue the others later. Again, for our purposes, we will concentrate on fresh water, and even more, limit it to a large extent to surface water (e.g. lakes, rivers, creeks, swamps, etc.).

Bear in mind though, that about forty per cent of Ontario's population take their drinking water from ground water that comes from wells, dug, drilled or flowing artesian. When pollution of this source occurs it is very serious indeed, since the correction of it is all but impossible. It is for this reason that sanitary landfill methods of garbage-disposal are now being watched so closely. Organic matter in this garbage decays or ferments and percolates down to the underground river which carries the ground water, called the "aquifer".

Pollution sources of fresh surface water may then be divided into three main categories:

- (1) domestic
- (2) industrial
- (3) agricultural

The first and second may be carried to the treatment works by sanitary sewers. On the other hand, storm sewers pick up the run-off from the streets and run directly to the natural waters. Occasionally, drains lead directly to the watercourse from the offending source. This is rapidly being corrected.

The third pollution source is agricultural wastes. These are washed from the surface of the land by sheet erosion in spring, or in a heavy downpour in seasons when the ground is bare, or they percolate through the soil to end in the watercourses, or are carried by tiles, drains and ditches to them.

All three types of pollutants can be subdivided into two headings: organic or inorganic wastes. Organic wastes are capable of being broken down into carbon, oxygen and hydrogen by treatment or by natural agents, such as sunlight or oxygen which is dissolved in clean water, and thus are totally changed. Inorganic wastes contain minerals and chemicals: salt, sand, phosphates, nitrates, mercury, chrome, etc. The situation is not as simple as this sounds, because in all three forms of waste both organic and inorganic matter is often present.

High on the list of organic pollutants is the material associated with bacteriological pollution: the fecal or natural body wastes from man and animals. When water contains a high fecal bacteria count, it suggests that disease-carrying organisms may also be present. That is why a high *E. coli* count, though of itself not necessarily dangerous, indicates possible trouble from intestinal bacteria which may be there and which do carry disease. (Infectious hepatitis, diarrhea, dysentery, typhoid, etc.). Water is classed as "satisfactory" for drinking

purposes with a coliform count of 0 per 100 millilitres.

Bacterial pollution may come from inadequate sewage treatment plants, from unsatisfactory septic tanks, (either operating poorly, or badly situated and drained), or from drainage from farm operations, barnyards, etc. For years the scientist in the laboratory has been able to control this type of pollution with proper sewage plants and chlorine. But inadequate cottage or resort systems, municipalities which dragged their feet about installing sewage systems, and now the new method of raising animals, (hogs, chickens and cattle) in what can only be called animal factories raise problems which must be solved.

Sanitary and Storm Sewers

Sanitary sewers are a system of pipes that carry to the sewage or wastewater treatment plant domestic wastes from toilets, sinks, tubs, and basins; commercial wastes from food-handling and processing; and industrial wastes from factories, etc. The large trunk sewer which collects the flow from the individual establishments is usually located under the centre of the roadway with man-holes to the surface every 250-300 feet.

Storm sewers collect run-off from streets and parking-lots, and from weeping tile and roof drains around buildings and uncontaminated industrial processing waters. The metal gratings at the roadgutters are the inlets to them. Since it is considered that this run-off is primarily rainwater or melting snow, these usually run directly to the watercourse.

At a very few places, however, the sanitary sewers cross-connect with the storm sewers. The main purpose of this 'legal' cross-connection is to provide a safety-valve or overflow for emergency conditions. Such abnormal conditions may result from a blockage in the main sewer or extreme overloading because of intense rainfall. Under such conditions, it is considered preferable to have a weak dilution of sewage diverted with water to the watercourse which has some properties for self-purification or recovery, than to have the same material backing up into basements in the affected area.

Overflow or by-pass facilities are usually provided at treatment plants as relief in case of a long term power or equipment failure or excessive overloading. The use of such facilities is rare indeed, and is usually of short duration. If it does occur, it is during storms or in other conditions when the riverflows are high, thus considerable dilution takes place.

It should be kept in mind that high flows in the sewers to the treatment plant do not result in an overflow of any amount beyond 'normal'. What happens is that the sewage passes through the plant slightly more quickly and the treatment process (biological and chemical) does not have quite as long to operate. This means that all sewage gets less treatment than normal, rather than some getting the usual treatment and the remainder none. Since this occurs only when there is an extra high flow of water, there will then be more natural dilution.

In the Peterborough system for example, there is no place where the reverse process of storm sewers overflowing into sanitary sewers occurs. If this were to happen, it would increase the hydraulic load on the

sewers or the treatment plant. There is the exception of illicit connections of roof leaders, the legal but sometimes excessive contributions from foundation drains (e.g. from new, unsettled house foundation back-filling) or of sometimes excess surface water entering via sanitary man-hole tops.

Industrial waste from our factories and plants is a much more complicated question, involving many sophisticated elements, which were not dreamed of when the original plant was built. In some cases the treatment plant can remove these pollutants, in others it can't. In any case it is sometimes more reasonable to handle and treat the industrial wastes in a combined form at the central plant, while at other times separate pre-treatment at the source is preferred.

In Peterborough joint treatment is the most common. The classic case of an element that can't be removed easily from waste-water is phosphorous, present in the form of phosphates. Phosphorous comes from domestic wastes, including detergents, and from agricultural operations. Tertiary treatment, or three-stage plants are being developed now that take it out, and full-scale operating plants will be available soon. Research is being carried out for the removal of phosphorous from sewage lagoons, or as they are now more delicately called, waste stabilization ponds.

Why do we worry about phosphorous particularly? Because it is one of the foods, or nutrients, as they are called, required for the growth of algae. It is in other words, an excellent plant fertilizer.

Algae is the plant micro-organism at the base of the food chain:

the little fish feed on them, the bigger fish feed on the little ones, and man feeds on the big fish. If there were no algae there would be no fish.

Trouble looms when there is too much phosphorous in the water. If circumstances are conducive, an overbloom of algae results. These little organisms wash up on shore, and in the process of decaying, use up the oxygen which is dissolved in the water, making the water useless for other forms of life. During decay the algae are ugly, smelly and actually can be dangerous as they may be poisonous. It is ironic that fertilizers that make things grow can cause the 'death' of a water body. This comes of course from an over-growth of plant-life.

Phosphorous in the form of phosphates comes from four main sources:

- (1) excrement in domestic wastes
- (2) detergents which contain it 'to make clothes whiter'
- (3) ground surface run-off from urban areas
- (4) the run-off in spring from farmers' fields which have been fertilized.

Some lakes and rivers, because of their nature, are always going to be rich in phosphorous. If a lake is relatively shallow or if it has a high proportion of natural vegetation either contained in it or falling into it, it will usually receive more phosphorous than seems desirable. Such lakes are our Kawarthas. For this reason, it is doubly important for us to ensure that any artificial additions are removed, as those from improperly treated sewage, detergents, or farms.

It is therefore up to us to assist our Ministry of the Environment

in the campaign to improve the sewage disposal system for the municipalities, industries, cottages and resorts of our area. This will cost you money, and you must do without some luxuries to achieve it, but it is the duty of all of us, as responsible citizens to make this personal sacrifice in order to preserve our natural resources.

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